Circular Motion:

I swing a mass on a string in a circular path.

a) if I let go, what is the path of the mass?
b) what factors influence the tension in the string?
c) what minimum speed is required for the mass to swing in a vertical plane?
d) what is the tension in the string at the i)top ii) middle iii) bottom of the swing?
e) How can I swing the bucket of water over my head and not get wet?

Tuesday November 14th, we will do the flying pig lab. How does the length of the string influence the period of revolution of a toy pig on a string?

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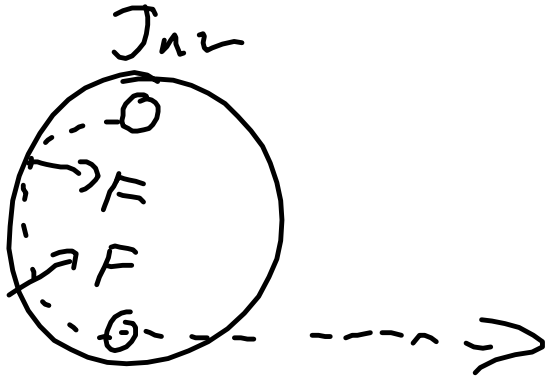


No Jav

ball goes tangent to the circle

to the circle
- Law of inertia
- No F, so no circular motion
- all circular motion requires a net force ∴ acceleration

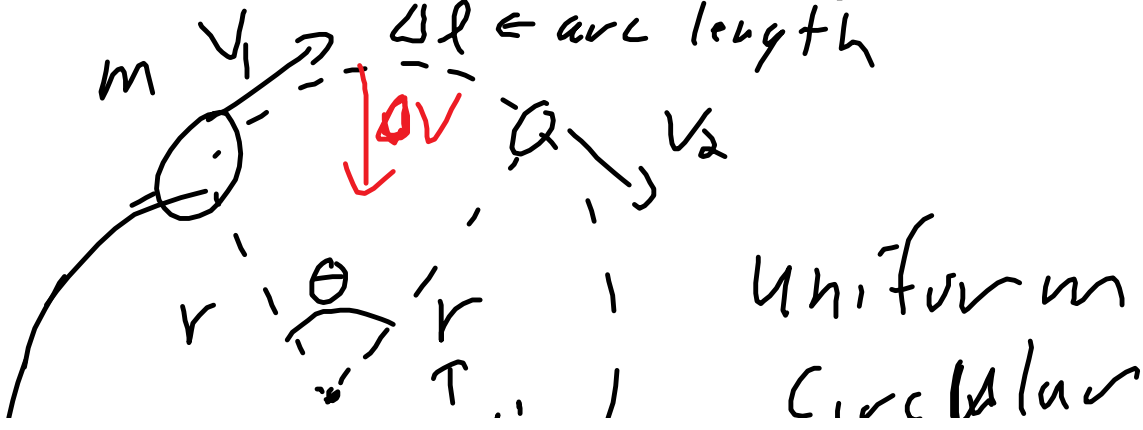
b) what factors influence the tension in the string?

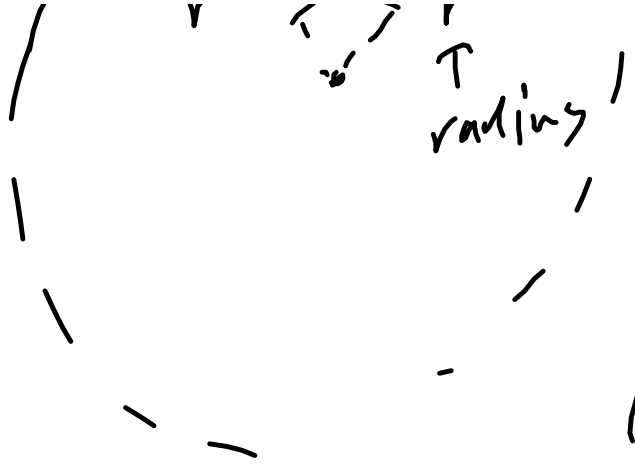
- horizontal plane: speed, mass, radius of the circle

vertical plane: same and gravity, and position
lowest tension at the top, highest at the bottom

c) what minimum speed is required for the mass to swing in a vertical plane?

we need to derive our equation relating the acceleration in circular motion to the speed.

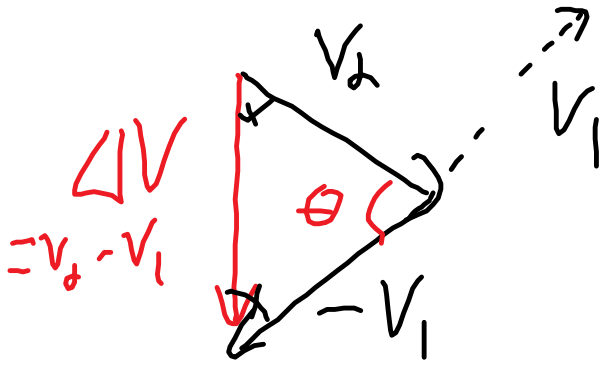


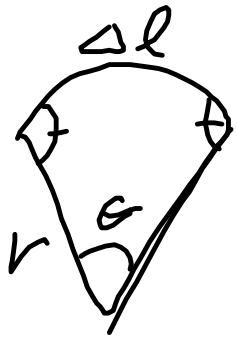


Circular motion
- constant speed
(NOT Velocity!!)

$|V_1| = |V_2|$

$a = \frac{\Delta V}{\Delta t} = \frac{V_2 - V_1}{\Delta t}$ Vector Subtraction





$\frac{\Delta V}{|V|} = \frac{\Delta \ell}{r}$

↑ Speed

$\Delta V = \Delta \ell V/r$ $a = \Delta V/\Delta t = \Delta \ell V/r\Delta t$

$\Delta \ell/\Delta t$ = speed = V

$a = v^2/r$ objects in circular motion accelerate towards the centre of the circle with an acceleration equal to the square of the speed over the radius of the circle.

therefore the net force, $F_{net} = ma = mv^2/r$

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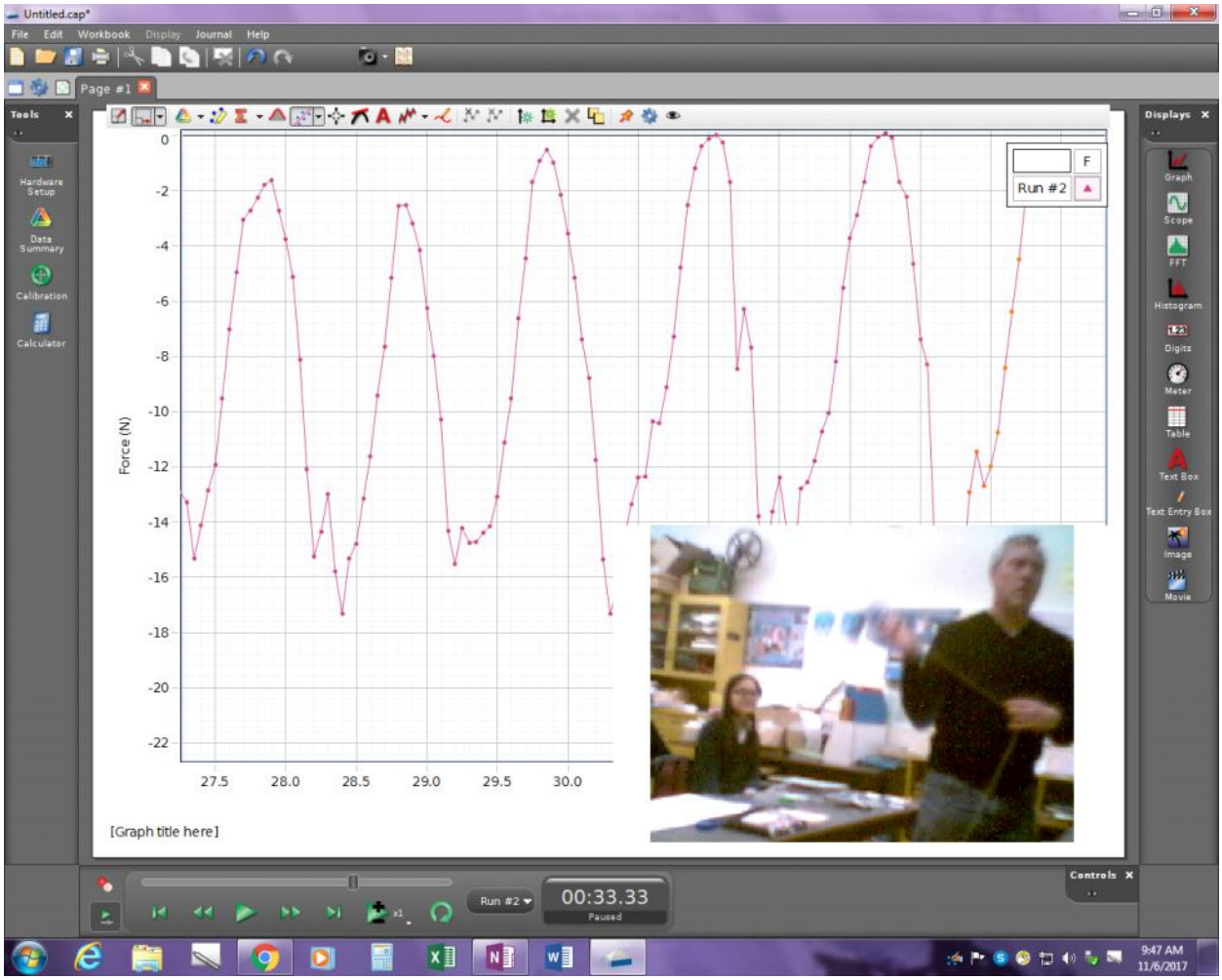
if the speed is not uniform, the equation still works but refers to the centripetal component of the acceleration and net force (towards the centre of the circle).

$a_c = v^2/r$
$F_c = mv^2/r$

a) what is the tension in the string at the i)top ii) middle iii) bottom of the swing?



a) How can I swing the bucket of water over my head and not get wet?

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eg. I swing a 500.0g mass on a digital force scale in a circular path radius 50.0cm. What does the scale read when

a) the mass just hangs without swinging?
b) I swing the mass at the bottom of the swing with a speed of 2.0 m/s.
c) the mass swing at the side at 2.0 m/s
d) what is the minimum speed at the top for it to stay in circular motion? (hint - tension =0)
e) what is the tension at the top if it is moving at 2.0 m/s?
f) what period of revolution is required to move the mass at 2.0 m/s

- p119-120 conceptual questions 1-5 practice problems 1-5